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WATER SUPPLY AND WATER QUALITY CONTROL
REQUIREMENTS, SHIDLER RESERVOIR, SALT
CREEK, OKLAHOMA

Public Health Service
Dallas, Texas

September 1962

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WATER SUPPLY AND WATER
QUALITY CONTROL REQUIREMENTS

SHIDLER RESERVOIR

SALT CREEK

OKLAHOMA

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DEPARTMENT OF HEALTH, EDUCATION, AND WELFARE
Public Health Service, Region VII
Dallas, Texas

In Cooperation with the

DEPARTMENT OF THE ARMY
U. S. Army Engineer District--Tulsa, Oklahoma

SEPTEMBER 1962

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I. INTRODUCTION

In a letter dated March 22, 1962, the Corps of Engineers, Tulsa District, requested the Public Health Service to "... review and finalize its data on water quality, value, and needs in the Shidler area, giving consideration to possible water quality control storage requirements in addition to municipal and industrial needs. In line with present criteria, consideration should be given to water requirements for a 100-year future period."

This study has been made in accordance with: (1) the Water Supply Act of 1958 (Public Law 85-500, Title III) and a Memorandum of Agreement between the Department of the Army and the Department of Health, Education, and Welfare, dated November 4, 1958; and (2) the Federal Water Pollution Control Act (Public Law 84-660) as amended by Public Law 87-88.

Successful completion of this study would not have been possible without the assistance of organizations who gave counsel and technical advice and made their files, publications, and records available.

Special appreciation is expressed to the following:

Oklahoma State Department of Health, Oklahoma City,
Oklahoma

Oklahoma Water Resources Board, Oklahoma City, Oklahoma
Bureau of Water Resources Research, the University of
Oklahoma, Norman, Oklahoma

Bureau of Business Research, the University of Oklahoma,
Norman, Oklahoma

U. S. Army Engineer District--Tulsa, Tulsa, Oklahoma

U. S. Bureau of the Census

U. S. Geological Survey

II. SUMMARY AND CONCLUSIONS

Summary

1. Shidler Reservoir will be located near the town of Shidler on Salt Creek, a tributary to the Arkansas River, in Osage County, Oklahoma.
2. The area to be served by Shidler Reservoir includes the towns of Fairfax, Shidler, Webb City, and Burbank.
3. Oil and gasfield activity, ranching and farming dominate the economy in the vicinity of the watershed.
4. The proposed reservoir will have 29,500 acre-feet of flood control and 11,000 acre-feet of conservation storage. The conservation pool will yield 4.5 million gallons per day (mgd).
5. The water to be impounded in the reservoir is of very good quality.

Conclusions

1. The area to be served by Shidler Reservoir had a 1960 population of 3,417 and is expected to increase to 5,900 in 2020 and 9,500 in 2070.
2. Oil and gasfield activity, ranching and farming are expected to continue as the dominating factors of the economy. Some petroleum and petrochemical and food processing industrial growth is expected in the area.
3. Shidler Reservoir will supply water to meet the requirements (including both municipal and service industries) of Shidler-Webb City, Fairfax, and Burbank totaling 0.99 mgd and 1.80 mgd in 2020 and 2070, respectively.
4. An additional potential industrial water need for petroleum and petrochemical industry and food processing of 0.75 mgd in 2020 and 1.05 mgd in 2070, respectively, is anticipated.

5. Water required for quality control in Salt Creek will amount to 0.83 mgd in 2020 and 1.58 mgd in 2070.
6. Total water requirements to be supplied by Shidler Reservoir are shown in the following table:

	<u>2020</u>	<u>2070</u>
Municipal & Service Industries	0.99 mgd	1.80 mgd
Industrial	0.75 mgd	1.05 mgd
Water Quality	<u>0.83 mgd</u>	<u>1.58 mgd</u>
TOTAL	2.57 mgd	4.43 mgd

7. Storage in Shidler Reservoir will have an annual value of \$85,700 for municipal and industrial purposes and \$40,900 for water quality control purposes.

III. DESCRIPTION OF PROJECT

Shidler Reservoir will be located near the town of Shidler on Salt Creek, a tributary to the Arkansas River, in Osage County, Oklahoma. It will be about 10 miles east of Kaw Reservoir--a Corps of Engineers project on the main stem of the Arkansas River. See Figure 1.

Tentative plans by the Corps of Engineers are for a multi-purpose reservoir with storage of 29,500 acre-feet for flood control and 11,000 acre-feet to meet municipal and industrial requirements. The conservation pool will have a dependable yield of 4.5 million gallons per day.

As indicated in Table III-1, Shidler Reservoir will have water of significantly higher quality than the Kaw Reservoir. Total dissolved solids, total hardness, chlorides, sulfates, and manganese concentrations in the waters of the proposed impoundment will be acceptable for almost all manufacturing processes without special treatment.

Table III-1

Chemical Quality of Kaw and Shidler Reservoirs

	<u>Kaw</u>	<u>Shidler</u>
Total Dissolved Solids, ppm	910 <u>1/</u>	220
Total Hardness, ppm	260	160
Noncarbonate Hardness, ppm	115	10
Cl, ppm	310 <u>1/</u>	10
SO ₄ , ppm	105	15

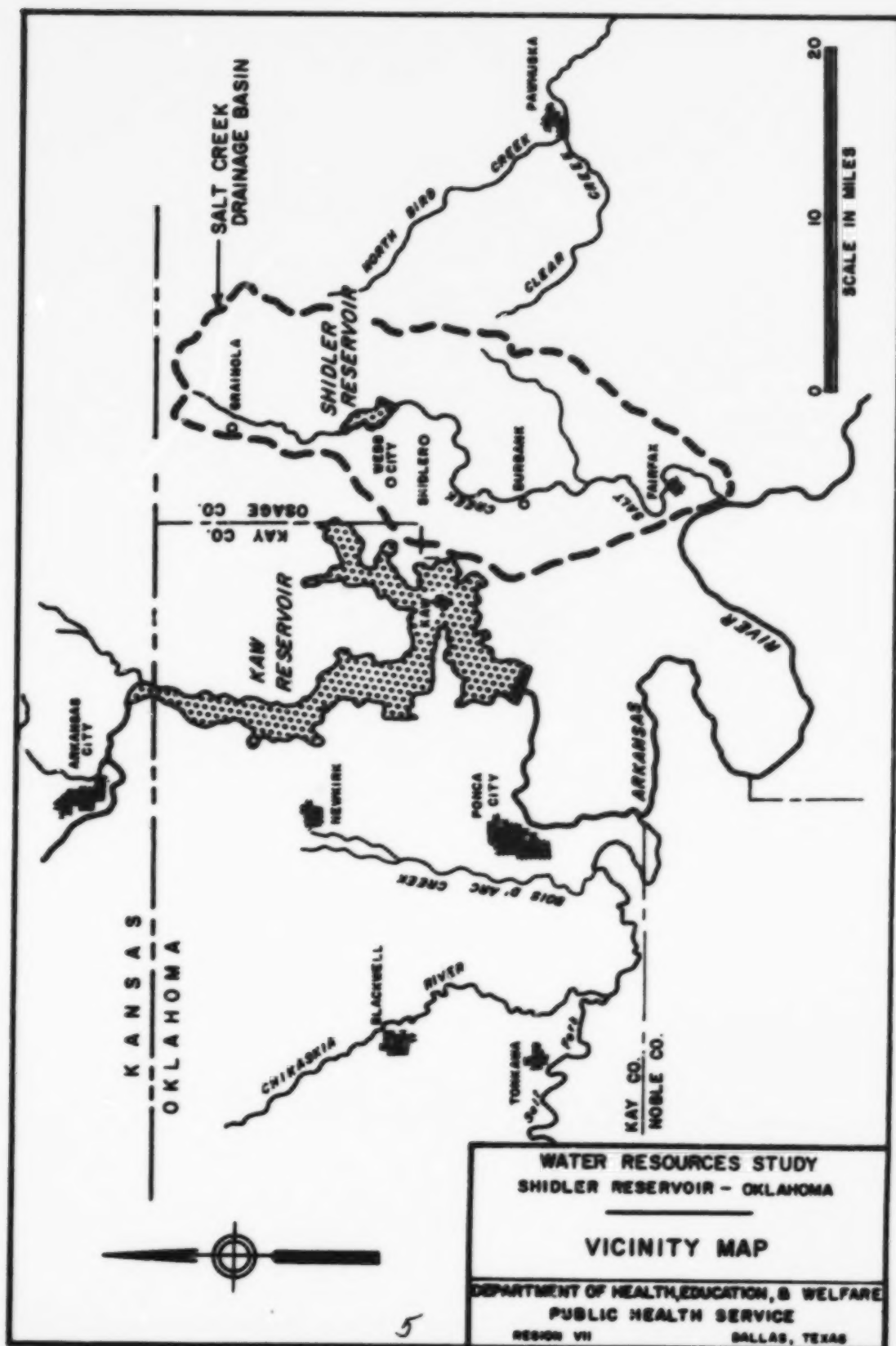


FIGURE 1

IV. DESCRIPTION OF PROJECT AREA

The project area lies in north-central Oklahoma, as shown in Figure 1. The topography is made up of gently rolling grasslands with some outcroppings of limestone. The drainage area is essentially free of characteristics or activities which would cause deterioration of the impounded water quality. One small community, Grainola, with a population of 80, lies within the drainage area. The wastes from this community can readily be controlled by standard sewage treatment. Other than this, there are only isolated farmhouses evident within the watershed.

The entire Salt Creek watershed occupies only a small part of western Osage County and is located a few miles directly east of Kay County. The area has a number of small streams in which the flow varies from zero to large flood flows. The main stem of the Arkansas River traverses the area some 10 miles west of the proposed Shidler Dam.

The economy of Kaw and Osage Counties is based upon petroleum, gas and natural gas liquids, ranching and farming, and manufacturing especially related to petroleum activities. Relative employment data are shown in Table IV-1.

The economy in the immediate vicinity of the watershed is similar to that of the county except that ranching and farming are more important and manufacturing is negligible. Oil and gasfield activity, ranching and farming will continue to dominate the economy.

The town of Shidler will remain a local distributing center for oilfield equipment. Fairfax will expand its packing house operations.

With the exception of larger communities, the area's population pattern has been one ranging from only moderate growth, in the decades from 1920 to 1940, to a decline between 1940 and 1960 as indicated in Table IV-2.

Table IV-1
Distribution of Labor Force ^{2/}
In the Study Area
1960

<u>Item</u>	<u>Kay County</u>		<u>Osage County</u>	
	<u>Number</u>	<u>%</u>	<u>Number</u>	<u>%</u>
Total Labor Force	19,056	100.0	11,385	100.0
Farm	1,488	7.8	1,158	10.2
Mining	325	1.7	1,761	15.5
Construction	924	4.8	754	6.6
Manufacturing	5,822	30.6	1,212	10.6
Resource-Oriented	3,879	20.4	570	5.0
Food and Kindred	361	1.9	89	0.8
Stone, Clay, and Glass	119	0.6	77	0.7
Other Nondurables	3,399	17.9	404	3.5
Nonresource-Oriented	1,943	10.2	642	5.6
Fabricated Metals, Mach.	1,542	8.1	375	3.3
Textiles	113	0.6	170	1.5
Printing and Publishing	288	1.5	97	0.8
Services	9,933	52.1	6,049	53.1
Unemployed	564	3.0	451	4.0

Table IV-2
Population Trends of Osage ^{a/} and Kay ^{b/} Counties

	Total Population ^{2/}			% Change for Decade			% Rural		
	1930	1940	1950	1960	1930-1940	1940-1950	1950-1960	1930	1940
Osage County	47,334	41,502	33,071	32,441	-12.3	-20.3	-1.9	5/	5/
Shidler	1,177	718	840	870	-40.0	+17.0	+3.6	--	--
Fairfax	2,134	2,327	2,017	2,076	+9.0	-13.3	+3.0	--	--
Webb City	493	352	284	233	-28.6	-19.3	-18.0	--	--
Burbank	372	329	268	238	-11.6	-18.5	-11.2	--	--
Pawhuska	5,931	5,443	5,331	5,414	-8.2	-2.1	+1.6	--	--
Kay County	50,186	47,084	48,892	51,042	-6.2	+3.8	+4.4	5/	5/
Ponca City	16,136	16,794	20,180	24,411	+4.1	+20.2	+21.0	--	--
Blackwell	9,521	8,537	9,199	9,588	-10.3	+7.8	+4.2	--	--
Tonkawa	3,311	3,197	3,643	3,415	-3.4	+14.0	-6.2	--	--
Newkirk	2,135	2,283	2,201	2,092	+6.9	-3.6	-4.9	--	--

^{a/} With separate trends for all towns in study area as well as Pawhuska.
^{b/} With separate trends for all principle cities and towns over 2,000 population.
^{c/} Data not available.

V. MUNICIPAL WATER SUPPLY NEEDS

An examination of Figure 1 shows that the development of Kaw Reservoir will preclude Shidler Reservoir as a source of water supply for any area west of the Salt Creek basin or below Kaw Reservoir on the Arkansas River. Considering the distance to and size of the nearest communities, the Shidler site does not appear to be a feasible source of water supply to the east and north of the Salt Creek basin. The area to be served by Shidler Reservoir includes the towns of Fairfax, Shidler, Webb City, and Burbank.

Shidler now purchases water from the Phillips Petroleum Company and supplies water to Webb City. The combined use of these two communities in 1958 was 0.04 mgd. Shidler has requested 0.15 mgd of water from Shidler Reservoir to meet its future water supply needs.

Fairfax takes its water from Fairfax Lake which has proven to be an inadequate source during drought periods. In 1958, Fairfax had a water supply need of 0.29 mgd. It is believed that the city will contract for water supply storage in Shidler Reservoir to meet its future needs.

Burbank had a water supply need of 0.02 mgd in 1958, which it met from one well and a nearby creek. The well has gone dry during drought periods. It is believed that Shidler Reservoir will provide a dependable and feasible source of water to meet Burbank's future needs.

The development of the Shidler site is expected to reverse the present downward trend in population beginning with the initial construction period. A growth rate comparable to the Ponca City subarea as described by the Arkansas-Red Rivers study ^{3/} has been projected to the year 2020. A lesser growth rate is predicted from 2020 to 2070. The area to be served by Shidler Reservoir had a 1960 population of 3,417 and this is expected to increase to 5,900 in 2020 and 9,500 in 2070.

Shidler Reservoir will supply water to meet the requirements (including both municipal and service industries) of Shidler-Webb City and Fairfax, totaling 0.99 mgd in 2020 and 1.80 mgd in 2070.

VI. INDUSTRIAL WATER SUPPLY NEEDS

The Arkansas-Red Rivers study ^{3/} forecasts water requirements of 150 mgd for the petroleum and petrochemical and 1.0 mgd for food and kindred industries by 2020 in the Ponca City subarea. These requirements are expected to increase to 200 mgd and 1.5 mgd, respectively, by 2070.

It is anticipated that 10 percent of the petroleum and petrochemical production will be located so as to utilize the relatively high quality Shidler water for its contact process supply, while meeting its predominant cooling water needs from the Kaw Reservoir. Expectations are that 3 percent ^{3/} of the total requirement will be for contact process use. The total petroleum and petrochemical need from Shidler Reservoir should be 0.45 mgd and 0.60 mgd in 2020 and 2070, respectively.

Food producers are expected to locate near Fairfax to take advantage of existing rail and highway transportation facilities and possibly river transportation. It is expected that 30 percent of the water requirements for food processing will be met from Shidler releases or a total of 0.3 mgd in 2020 and 0.45 mgd in 2070.

VII. WATER QUALITY CONTROL NEEDS

The controlling factor for water quality is that of nitrate concentration. In order to maintain the State of Oklahoma standard for nitrates of 10.0 ppm 4/ throughout the basin, it will be necessary to augment the streamflow with 0.83 mgd in 2020 and 1.58 mgd in 2070.

The dilution necessary to maintain 4.0 ppm dissolved oxygen concentration (D.O.) will be .63 and 1.23 mgd in 2020 and 2070, respectively. Therefore, the regulated flow will more than satisfy minimum D.O. requirements while maintaining the nitrate standard and also eliminate reported offensive ponding and stagnation.

VIII. VALUE OF STORAGE FOR MUNICIPAL,
INDUSTRIAL, AND WATER QUALITY CONTROL PURPOSES

Storage in Shidler Reservoir has a value equal to the cost of the most feasible, equivalent, alternative means of meeting the expected water needs.

Alternative plans could possibly be developed to meet expected water needs. These include use of ground water development of alternate inbasin reservoir sites and transbasin diversion.

Sources of ground water in the area yield neither sufficient quantity or satisfactory quality to meet future needs. Alternate inbasin reservoir sites are limited and would prove more costly to develop and provide transportation to the point of need. Transbasin diversion of water proved infeasible because of transportation costs and inferior water quality.

A single-purpose reservoir at the Shidler site has been selected as the most feasible equivalent, alternative means of meeting municipal, industrial, and water quality control needs in the study area. The first cost and annual operation, maintenance, and replacement costs for this reservoir have been supplied by the U. S. Army Engineer District, Tulsa, Oklahoma. The first cost has been amortized at a 4 percent rate of interest and annual cost has been calculated to reflect a 50-year payment period. On this basis, storage in Shidler Reservoir will have an annual value of \$85,700 for municipal and industrial purposes and \$40,900 for water quality control purposes.

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